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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

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LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

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DOUGLAS FIR PLYWOOD

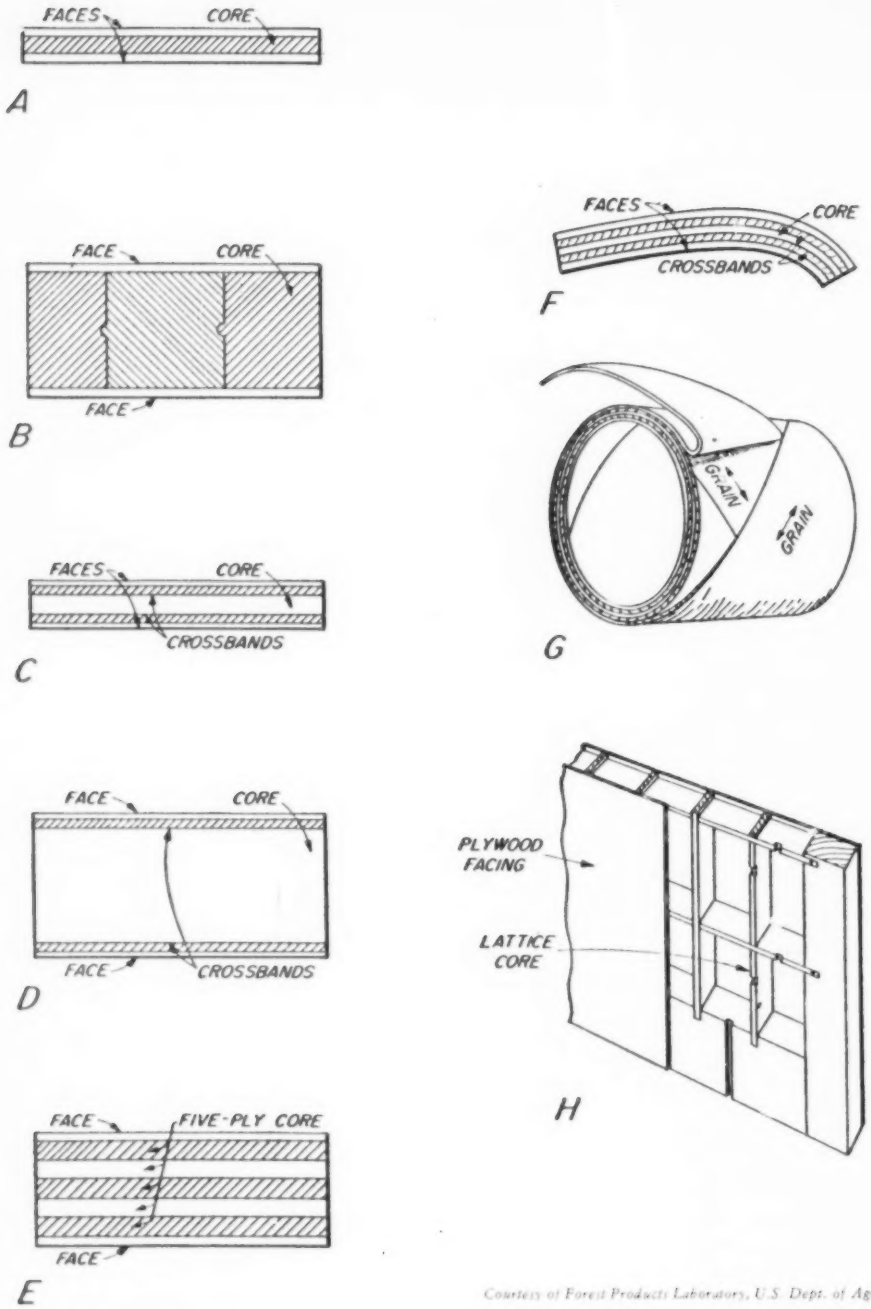
PLYWOOD is a term generally used to designate glued wood panels that are made up of layers or *plies* with the grain of 1 or more layers at an angle, usually 90°, with the grain of the others. The outside plies are called *faces* or *face* and *back*, the center ply or plies are called the *core*, and the plies immediately below the face and back, laid at right angles to them, are called the *crossbands*. The essential features of plywood are embodied in other glued constructions with many variations of details. The core may be veneer, lumber, or various combinations of veneer and lumber; the total thickness may be less than 1/16 inch or more than 3 inches; the different plies may vary as to number, thickness, and kinds of wood; and the shape of the members may also vary. The crossbands and their arrangement largely govern the properties, particularly the warping characteristics, and the uses of all such constructions.

As compared with solid wood, the chief advantages of plywood are its approach to equalization of strength properties along the length and width of the panel, greater resistance to checking and splitting, and less change in dimensions with changes in moisture content. The greater the number of plies for a given thickness, the more nearly equal are the strength and shrinkage properties along and across the panel and the greater the resistance to splitting.[1]

[1] The preceding two paragraphs, less italics, are quoted from Wood Handbook No. 72 (1955), Forest Products Laboratory, U. S. Dept. of Agriculture.

The water or weather resistance, and to a lesser extent the strength of any plywood, is largely determined by the properties of the adhesive used to bond the plies together. The bond provided by a modern adhesive is stronger than the wood itself. Figure 1 presents cross sections of several common plywood constructions.

Plywood made from hardwoods (oak, beech, maple, birch, cherry, gum, walnut, mahogany, etc.) is largely used in furniture and other indoor applications. Appearance is usually of prime importance, consequently the exposed face plies are very thin veneers usually *sawn* from quarter sections of selected highly-figured veneer logs. Two adjoining cuts from the same log are so thin that they have essentially the same grain pattern, consequently one can be reversed and the pair carefully matched to give spectacular decorative effects. Hardwood plywoods also include many special forms like those illustrated in sketches F, G and H of Figure 1, and special laminates composed of hardwood cores faced with hardboard, aluminum, stainless steel, or thin paper-reinforced layers of hard thermo-setting plastics of the phenol formaldehyde or urea formaldehyde types for use as counter tops. Thus the hardwood segment of the plywood industry is characterized by relatively small production in each of a large number of highly specialized forms. As a consequence of such complexity in the hardwood plywoods, the remainder of this article will be confined to the large



Courtesy of Forest Products Laboratory, U.S. Dept. of Agriculture

Figure 1 — Types of plywood and crossbanded construction: A, 3 ply (all veneer); B, 3 ply (lumber core); C, 5 ply (all veneer); D, 5 ply (lumber core); E, 7 ply (all veneer); F, 5 ply bent work (all veneer); G, 5 ply, spirally wrapped (all veneer); H section of hollow-core door.

scale manufacture of "softwood" plywood, and specifically to Douglas fir plywood which constitutes the largest bulk of the entire plywood industry.

DOUGLAS FIR PLYWOOD

Douglas fir (pseudotsuga menziesii) is a remarkable wood which combines great strength with light weight. With a specific gravity of only 0.48 its modulus of elasticity (a measure of stiffness) is 1,950,000 psi which is only slightly exceeded by such scarcely-available and much heavier hardwoods as oak, hickory and birch. As an indication of overall strength, the ratio of the moduli of elasticity obtained tangential to growth rings to that obtained parallel to the grain is 0.061 which again is exceeded only slightly by such heavy hardwoods as ash (0.064) and mahogany (0.064).

Wholly unlike the sawn hardwood veneers, Douglas fir plywood veneer is manufactured by the *rotary cut* method in which the fir log is rotated in a giant powerful lathe while a long knife "peels" or "unwinds" a thin continuous sheet of veneer from its circumference. Plywood made from Douglas fir is one of the strongest materials known, consequently it is widely used in construction and engineering.

Since commercial stands of Douglas fir are found only on the western slope of the Cascade mountains, Douglas fir plywood is manufactured only in Oregon (83 plants), Washington (34 plants) or British Columbia (26 plants). One plant alone produces 180 million square feet and all 143 annually manufacture 7.8 billion square feet. Only four years of such production could furnish a fir plywood roof over the entire state of Rhode Island!

FIR PLYWOOD TYPES

Exterior type fir plywood is made with a completely waterproof adhesive ("glue") of the thermosetting phenolic type which is of higher cost than less capable materials but gives a bond that is stronger and more durable than the wood itself. As indicated by its name, the exterior type is used where the plywood will be exposed to heavy weather and moisture conditions such as: fences, carports, signs, boats, exposed siding or sheathing on buildings, outside doors, flooring underneath tile, linoleum or carpeting where moisture may be a problem and reusable concrete construction forms (usually oiled during manufacture to prevent adhesion and roughening of the concrete).

Interior type fir plywood is made with a highly moisture resistant (but not absolutely waterproof) adhesive and is therefore best suited for such interior applications as: wall and ceiling panels, flooring, furniture, thin partitions, shelving, siding or sheathing to be covered or protected by shingles and inside doors.

Special type fir plywoods of either interior or exterior construction are made with such special features as: brushed, embossed, or striated surface finishes; fused resin fiber overlay having a particularly hard and smooth surface; hardboard facing on one or both sides; naturally finished heartwood surface veneer with solid core construction for furniture; solid core exterior type panels for marine usage.

FIR PLYWOOD GRADES

The following six grades of fir plywood veneer are determined by their appearance and quality and are listed in descending order:

Grade	*Veneer Quality*
N	Special order "natural finish" veneer. Select, all heartwood. Free of open defects.
A	Best standard veneer. Smooth and paintable. May be more than one piece but well jointed. Neatly made repairs permitted.
B	Solid surface veneer. Circular repair plugs and tight knots permitted.
C Repaired	Improved "C" veneer. Underlayment grade.
C	Minimum veneer quality permitted in Exterior type. Knotholes to 1 inch, splits, plugs and other repairs permitted.
D	Used only for inner plies and backs of interior panels. Limited amount of "white pocket" permitted.

The type and grade of fir plywood is usually stencilled on the back or branded on an edge and consists of a series of letters. For example a marking such as EXT DFPA A-C indicates an exterior type plywood meeting DFPA (Douglas Fir Plywood Association) standards and having face and back surfaces of A and C grades respectively.

FIR PLYWOOD SIZES

Standard fir plywood panel thicknesses (with *minimum* number of plies given in parentheses) are as follows: 3/16″(3); 1/4″(3); 5/16″(3); 3/8″(3); 1/2″(5); 5/8″(5); 3/4″(5); 1″ and 1 1/8″(7). Additional plies are obtainable on special order. Standard interior and exterior type panels are normally 3 or 4 feet wide and 8 feet long. Special type panels are obtainable as narrow as 16″ and (for boat hull construction) as long as 30 feet.

FIR PLYWOOD MANUFACTURE

The manufacture of fir plywood obviously begins with the felling of selected large-diameter trees and the transport of the logs by water, truck or rail to the plywood plant. The equipment and methods

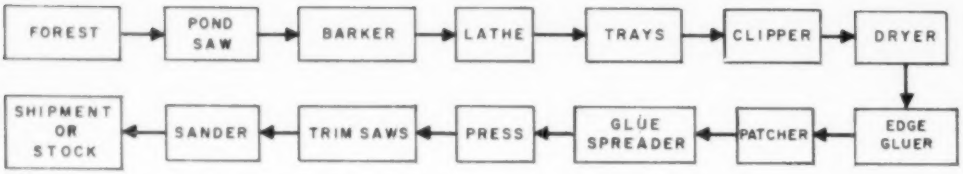


Figure 2 — Schematic flow diagram for fir plywood manufacture.

used in large scale logging of such heavy timber has been described in a previous issue[2] of this publication. Large-diameter logs fifty or more years old are required. Though the moderate temperatures and high humidity conditions of the Pacific northwest accelerate timber growth remarkably, foresighted timber users are conserving and perpetuating their supply by careful cutting and replanting. In itself the rotary cutting process used in fir plywood manufacture is highly efficient since practically no usable wood is wasted in sawdust or other scrap. Figure 2 presents a schematic flow diagram of the several manufacturing steps between the standing tree and delivery of the finished plywood to the consumer.

Pond Saw

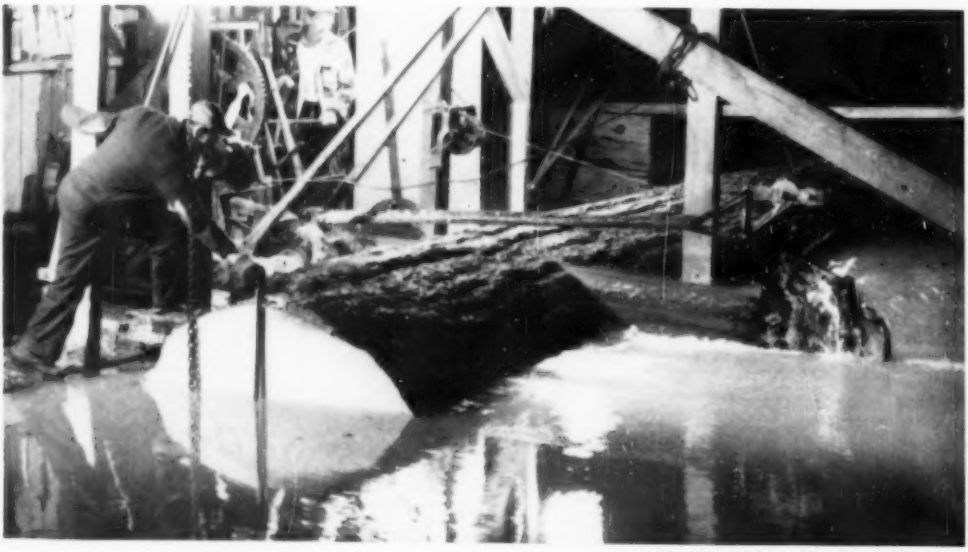
Transformation of the log into plywood begins in the log pond or storage pond adjacent to the plywood plant where the log has been temporarily stored to facilitate handling and to keep it clean. That portion of the plywood plant in which the log or veneer is still wet is called the "green end". Figure 3 illustrates the first manufacturing step, that of "scaling" (measuring) and chain-sawing the log into suitable lengths called *peeler blocks* or *peelers* by means of the *pond saw*. Peelers are usually just over eight feet long since, as previously noted, most fir plywood panels are of this length.

Since the anti-friction bearings on both motor and saw must operate under extreme moisture conditions, they should be lubricated and protected with the NLGI[3] No. 2 grade of a heavy-oil multi-purpose type grease which is highly resistant to water washing and acts as a seal to prevent water ingress. As indicated in Figure 3, the chain and bar of the large chain saw must operate while partially or wholly submerged in the pond water. Excessive wear of these heavily loaded parts is prevented by applying an adherent non-emulsifying corrosion-preventive lead soap type of extreme-pressure gear lubricant having a viscosity of about 3300 SUS[4] at 100°F. every four to eight hours.

[2] Magazine LUBRICATION, Sept., 1954 issue, "Logging and Sawmill Machinery Lubrication."

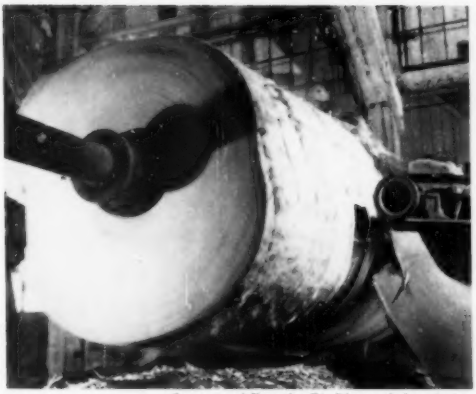
[3] National Lubricating Grease Institute.

[4] Saybolt Universal Seconds.



Courtesy of Douglas Fir Plywood Association

Figure 3 — Scaling a log in the pond and chain-sawing it into peeler block lengths.



Courtesy of Douglas Fir Plywood Association

Figure 4 — Barker removing bark from peeler block.

Barker

After hoisting from the pond, the heavy peeler is conveyed to the *barker*, illustrated in Figure 4. Here it is mounted between *chucks* on huge spindles and revolved at a controlled speed while a toothed *barking wheel*, rotating at high speed, is held against and moved along to literally grind away the bark.

Heavy shock loads on the large babbitted spindle bearings recommend the use of a heavy-oil multi-purpose grease in the NLGI No. 2 grade. The highly machined *spindle screws* (which force the chucks into the log ends) must be protected by brushing with a highly adherent corrosion-preventive gear lubricant like that used on the chain saw bar. The guides and ways of the barking wheel should be similarly lubricated.

While the barker shown in Figure 4 is the most common type at this time, some plants have installed *hydraulic barkers* which utilize high pressure water jets to remove the bark.

Lathe

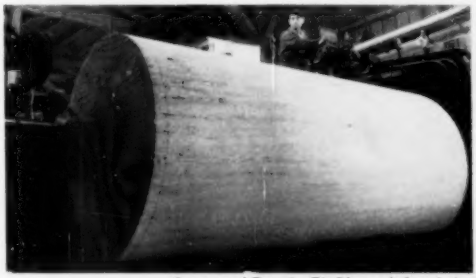
After debarking, the peeler is transferred to the *lathe* shown in Figure 5 by means of an overhead crane, lift chains and a pair of spiked tongs which engage the peeler on its ends (to avoid damaging its cylindrical surface from which the veneer will be removed). After centering and holding the peeler with the spindle chucks, it is rotated slowly but powerfully by means of a geared steam or hydraulic engine, while a long sharp longitudinal knife is pressed into it at a controlled depth so as to "peel" (i.e. cut and separate) a veneer layer of the desired thickness. As determined by its ultimate use, fir plywood veneer may be from one to three sixteenths of an inch in thickness. Veneer thickness does not correspond to growth rings; on the contrary the decorative grain pattern visible in Figure 5 is caused by differences between the somewhat irregular growth rings and the accurately controlled movement of the knife. During the rough cuts of the first few revolutions, the peeler becomes a true cylinder; thereafter the veneer is removed in a continuous sheet like that illustrated in Figure 6. When the peeler has been reduced to a diameter of about six inches it is replaced with a new one as shown in the background of Figure 6.

The speed of a steam-powered lathe is usually controlled by push buttons which regulate an electric and air actuated throttle governor. When supplied with saturated or wet steam, usually at about 150 psi, the cylinder of the approximately 150 HP non-condensing engine requires a heavy steam cylinder oil with a viscosity of about 2500 SUS at 100°F. and 5% to 10% of compounding. Cylinders of engines supplied with dry superheated steam, or condensing engines, utilize a very heavy straight mineral cylinder oil with a viscosity of about 4800 SUS at 100°F. In either type of engine, the crankshaft and crosshead bearings are usually lubricated separately with a rust and oxidation inhibited turbine-hydraulic oil having a viscosity of about 300 SUS at 100°F.

A hydraulic lathe motor is also usually supplied with a rust and oxidation inhibited turbine-hydraulic oil, having a viscosity of about 300 SUS @ 100°F. by means of an electric motor-driven constant volume pump. The large highly-loaded roller bearings which carry the lathe spindles are best lubricated and protected with the NLGI Grade No. 2 of a heavy-oil multi-purpose type grease.

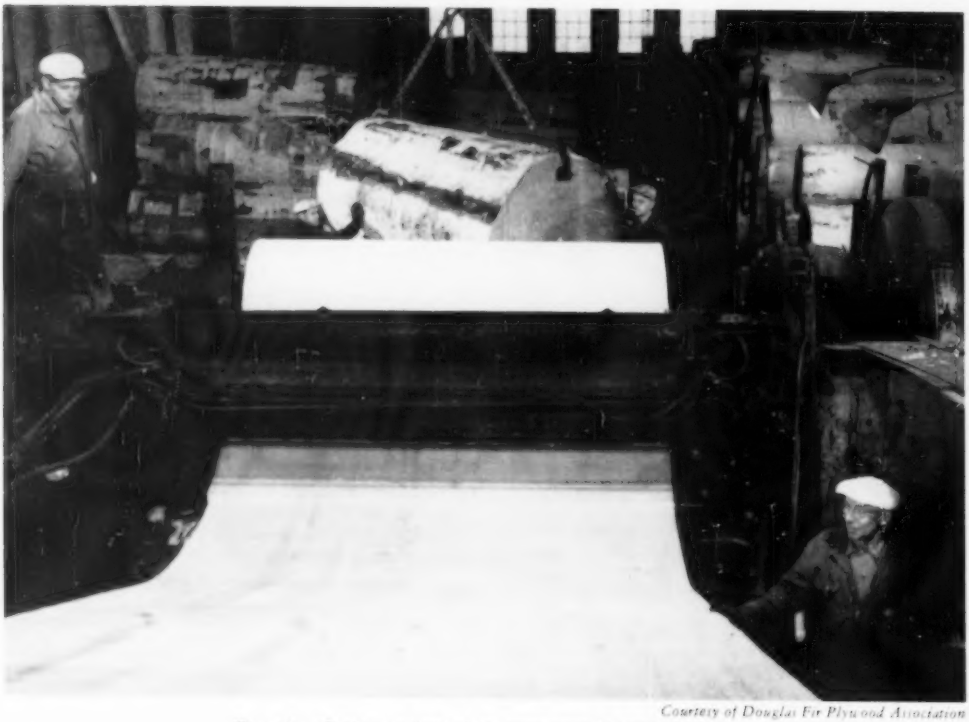
Trays

While running, the lathe produces a tremendous footage of veneer, followed by a no-production period necessitated by replacement of the peeler. To "even out" these production bursts, a series of *trays*, five or six decks high and about 200 feet long, are provided as temporary storage for the veneer. Rubber belt conveyors running at the same lineal speed as the veneer, receive it from the lathe and transport it to and through the trays as required by the next process.



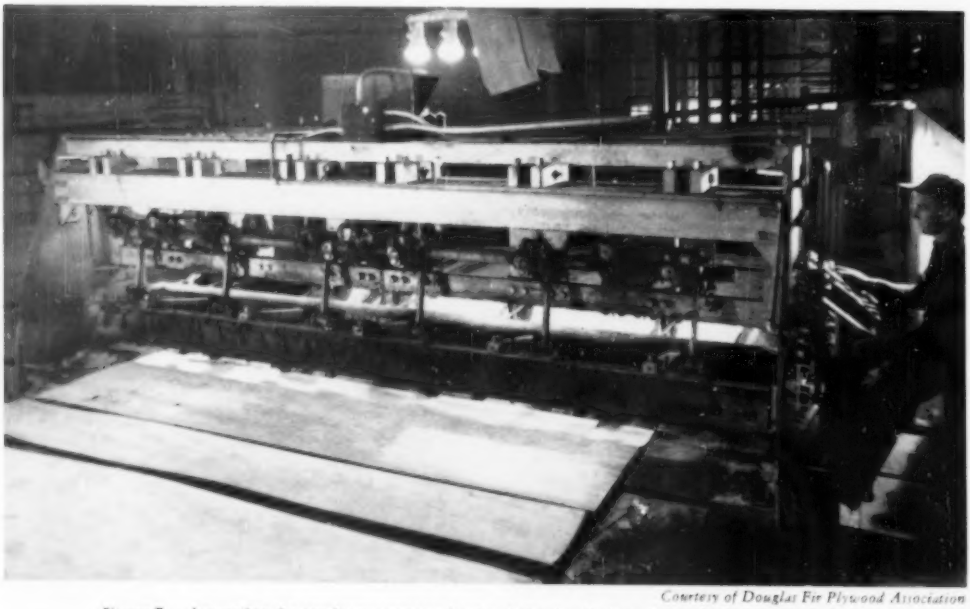
Courtesy of Douglas Fir Plywood Association

Figure 5 — Peeler block chucked in lathe and roughcut to cylindrical form.



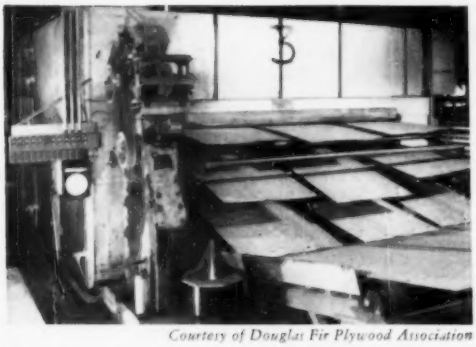
Courtesy of Douglas Fir Plywood Association

Figure 6 — Continuous sheet of fir veneer emerging from the lathe.



Courtesy of Douglas Fir Plywood Association

Figure 7 — Inspecting the continuous veneer sheet and clipping it along the grain into selected pieces.



Courtesy of Douglas Fir Plywood Association

Figure 8 — Discharge end of dryer showing carrier rolls and drive mechanism.

Clipper

As indicated in Figure 7, the *clipper* is a high speed shear used to "clip" the long sheet of veneer into widths best suited for assembly into plywood panels, and to cut out and reject any unsatisfactory portions.

Since the veneer sheet is moving, the highly skilled operator must be capable of making very quick inspections and decisions, while the push-button controlled air-operated shear blade must respond instantly to his command. To insure against hesitation or sticking caused by water, rust, gummy materials in the wood, or oxidized oil varnish, it is imperative that the air cylinder and control valves be lubricated with a rust and oxidation inhibited turbine-hydraulic oil having a viscosity of about 150 SUS at 100°F.

The clipper is the last machine in the green end of the plant, since its production of selected wet veneer pieces is transferred by conveyor belt or industrial truck to the dryers.

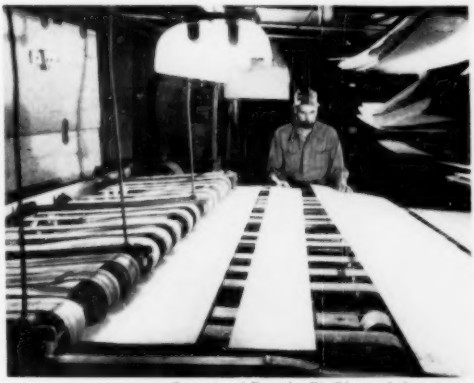
Dryer

As shown in Figure 8, the *dryer* is a huge oven, usually about 150 feet long, fifteen feet wide and high, and provided with five or six operating levels. Wet veneer, which has a moisture content of about 30%, is fed into the several levels where it is carried between pairs of rollers. Batteries of steam pipes maintain an internal temperature of about 350°F. while air is constantly blown through the dryer to carry off moisture. The dryer requires only a few minutes to reduce the moisture content of the veneer to less than 8% and to lower its temperature again to about 90°F., which facilitates subsequent handling and gluing.

Because high temperatures, high humidity and resinous or acidic wood "distillation" products are all present simultaneously, the dryer presents several interesting lubrication problems. Electric motor and exhaust fan bearings and some veneer carrier-roll bearings are best lubricated with the NLGI No. 2 grade of a heavy-oil multi-purpose type grease which not only withstands sustained operating temperatures of about 180°F. but effectively excludes moisture. Cased reduction gears on roller drives may be bath or spray lubricated with a rust and oxidation inhibited turbine-hydraulic oil having a viscosity of about 650 SUS at 100°F. The long roller-type chain which drives the veneer carrier-rolls offers special problems since it operates at a temperature of about 320°F. midst superheated steam and acidic wood vapors which encourage rust and wear while wood resin or pitch drops on and tends to build up in the links. However, such chains are being very successfully lubricated through drip oilers at the chain entry supplied with the SAE 30 grade of a highly detergent automotive engine oil which provides excellent rust protection, neutralization of acids and prevention of pitch deposits.

Edge Gluer

Figure 9 illustrates an *edge gluer* in which two or more veneer sheets that are too narrow to be used alone are jointed, assembled and "glued" together to form a large sheet. Veneer sheets intended for interior plies (where a neat joint is not essential) may be held together temporarily with paper tape until "glued" into a panel. On the contrary, surface plies are edge-glued before assembly into panels. However, a recently developed machine edge-glues narrow sheets electronically into a continuous sheet that is subsequently and exactly clipped to the desired panel widths.



Courtesy of Douglas Fir Plywood Association

Figure 9 — Selecting, assembling and edge-gluing veneer strips to be used as the face or back plies of a plywood panel. Edge-gluing is automatically performed within the cabinet at the reader's left.

Courtesy of Douglas Fir Plywood Association

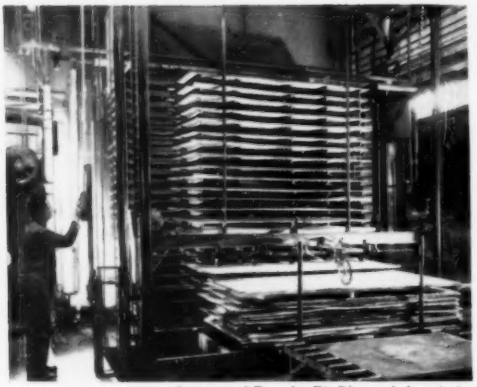
Figure 10 — Patcher machine being used to repair defects in face or back veneer.

Patcher

Since Mother Nature rarely does a perfect job, fir plywood veneer may contain small imperfections such as loose knots, open knot holes, pitch pockets or splits which do not appreciably affect its strength or durability but may be unsightly. If the veneer is suitable otherwise for the face or back of a high grade plywood panel, each imperfection is cut out as a seed-shaped piece with the *defect saw* and replaced with a similar but sound piece which is glued under heat and pressure by means of the *patcher* illustrated in Figure 10. (Some plants also incorporate the use of a "plug patcher" which punches out a circular section around the defect and inserts a patch under heat and pressure in one operation.) The result is so neat and the joints so tight that only the difference in grain may betray the repair. Parenthetically, the word "glue" is a misleading inheritance from the early days of the industry when water-sensitive animal-origin (gelatine or fish) glues which required hours or days of drying time were the only ones available; the term "adhesive" is

Courtesy of Douglas Fir Plywood Association

Figure 11 — Glue spreader being used to coat both sides of interior plies. In foreground, note the assembly of veneer strips into panels.



Courtesy of Douglas Fir Plywood Association

Figure 12 — Press loader receiving plywood panel assemblies preparatory to insertion in bonding press.

much more applicable to the modern water-resistant or water-proof synthetics which are heat-hardened chemically and permanently only a few minutes after application.

As hinted by the presence of the air line oiler at the upper left of Figure 10, the patcher's pistons, valves and controls are lubricated with a rust and oxidation inhibited turbine-hydraulic oil with a viscosity of about 150 SUS at 100°F.

Glue Spreader

Figure 11 portrays a *glue spreader* consisting of two large steel or rubber rolls forming one side of a glue box, the whole resembling the ink rolls and ink fountain on a printing press.[5] Veneer sheets intended for the internal plies of a panel are fed through the rolls which apply an even coat of adhesive to *both sides*. The workman in the center foreground is assembling these coated sheets crosswise on an uncoated face ply while the two workmen in the near foreground stand ready to apply the top quality face ply which will complete a three-ply panel. Obviously another layer of coated cross plies plus an uncoated face ply would make a five-ply panel, however it would be wasteful and unnecessary to use top quality plies in the interior of the panel (or in the other than the exposed surfaces of the face plies).

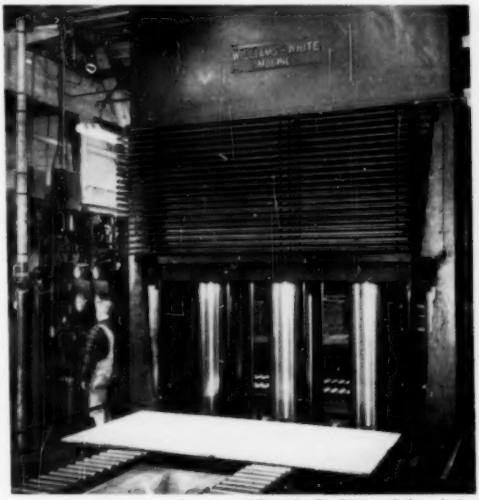
Press

The assemblies of still-separate glue-coated pieces of ply in each panel are now ready to be subjected to the heat and pressure of the press which will permanently "set" the adhesive and "weld" the pieces inseparably into panels. Figure 12 illustrates a *press loader* consisting of a series of trays which are used to accumulate (but keep separate) twenty panel assemblies and to load them simultaneously between the platens of the press. Figure 13 portrays the discharge side of a large hydraulically-operated press which contains the twenty-one steam-heated platens required to heat both sides of twenty panels to a temperature between 260°F. and 285°F. and to simultaneously subject them to a pressure of approximately 200 psi during a period of about 3 minutes. A "sample" five-ply panel rests on the conveyor in the foreground.

Hydraulic presses of this type normally employ electric motor-driven constant-volume pumps. The clearances in these pumps and the auxiliary control valves are so small that their efficient operation is seriously impaired or prevented by any oil contaminant such as sludge, rust or varnish. The oil in such a system is subjected to such adverse influences as violent agitation in the presence of atmospheric oxygen, high rates of shear, moisture and high temperatures. For these reasons, it is imperative to use a highly refined, shear-resistant, rust, oxidation and foam inhibited turbine-hydraulic oil having a viscosity between 150 and 300 SUS @ 100°F. for system operating temperatures between 25°F. and 170°F. All efficient systems incorporate cooling devices to maintain oil temperatures within these limits.

Trim Saws

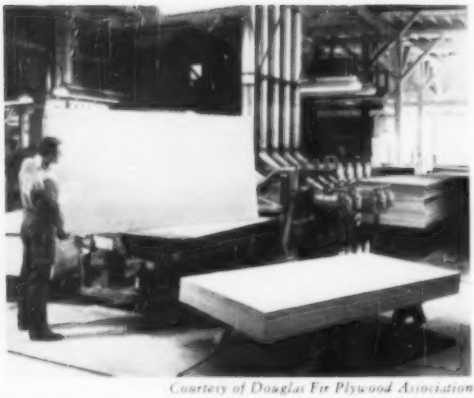
Circular fine-toothed crosscut and rip type saws are used to *trim* or cut the length and width of the rough panel respectively to finished dimensions.



Courtesy of Douglas Fir Plywood Association

Figure 13 — Hydraulic press applying heat and pressure simultaneously to twenty-one panel assemblies.

[5] Magazine LUBRICATION, Dec., 1959 issue, "Printing Lubrication."



Courtesy of Douglas Fir Plywood Association

Figure 14 — Drum sander simultaneously finishing both faces of plywood panels.

Sander

Figure 14 shows the discharge end of an electrically-driven double-drum sander used to finish both sides of a panel simultaneously while reducing its thickness to standard dimension.

Lubrication of the small roller bearings used in sander drums combines several problems. First, the drums not only turn at a high rotary speed but also oscillate longitudinally (to give the panel a better surface finish). Second, the bearings are grease fed from spring-loaded cups through rather small tubing. Thus the grease must be able to: (1) lubricate both high rotational speed anti-friction and sliding sleeve type bearings; (2) resist high temperature oxidation, working down and leakage; (3) withstand the grease separating effects of pressure and time; (4) pump easily through small tubing at normal temperatures. The recommended grease for this application is a multi-purpose type in the NLGI No. 2 grade.

Marking and Oiling

Figure 15 illustrates one method of marking plywood panels, that of using an electrically heated branding iron to burn the type designation on a panel edge. The panels shown are exterior type particularly useful for building sheathing and (when oiled) as concrete forms. Oil is used to facilitate separation of the plywood form from the hardened concrete without damaging the surface of the latter. The efficacy of this method is demonstrated by the many existing concrete structures in which the wood grain of the original plywood forms has been accurately reproduced and preserved in the cast concrete surfaces. Previously, such panels were oiled by hand swabbing on the construction site; now they are oiled in the plywood plant with a machine quite similar to the glue spreader shown in Figure 11, and using *form oil* having a viscosity between 70 and 100 SUS @ 100°F.

Auxiliary Equipment

To the maximum practical extent, the heavy logs, veneer and panels are moved through the plywood plant by means of conveyors, usually of the roller type depicted in Figures 11, 12 and 13. The rollers contain ball or roller bearings and (in the powered conveyors) are driven by electric motors through reduction gears and roller chains. Conveyor bearings are best lubricated with the NLGI No. 2 grade of a heavy-oil multi-purpose grease.

Where it is impractical to use conveyors, panels are moved by fork-lift trucks which are powered either with electric storage batteries or internal combustion engines. In recent years many gasoline engines on fork lifts used by the fir plywood industry have been converted to use liquified petroleum gas[6] which burns more completely under light-load part-throttle operation and thereby minimizes exhaust gas odors. With either type of fuel, the recommended engine crankcase lubricant is a "heavy duty" crankcase oil meeting Supplement One specification in the SAE 10W or SAE 30 viscosity grade.

[6] Magazine LUBRICATION, Nov., 1956 issue, "LPG-Engine Fuel and Lubricant Requirements."

Courtesy of Douglas Fir Plywood Association

Figure 15 — Electrically heated brand being used to burn plywood type designation on edges of finished exterior-type plywood panels.

SIMPLIFIED LUBRICATION PLAN FOR DOUGLAS FIR PLYWOOD INDUSTRY

Mechanism	Lubricant Symbol
Air cylinders; clipper & patcher	**Ra or Rc**
Air compressors	**Rc**
Circulating oil systems	
Steam engine crankcases	
Electric motor bearings, oiled	
Fan, blower, other oiled plain bearings	
Clipper bearings	
Hydraulic systems & motors	
Reduction gears, cased, spur or helical	**Rf**
Barker; screws and ways	**M_6**
Pond saw; chain and bar	
Reduction gears, cased, worm type	

Mechanism	Lubricant Symbol
Internal combustion engines	**H**
Dryer bearings, oiled	
Dryer roller chains	
Barker bearings	**MP**
Chipper bearings, greased	
Conveyor & tray bearings	
Dryer bearings, greased	
Electric motors, greased	
Lathe main bearings	
Steam engine cylinders, wet steam or non-condensing	**CC**
Steam engine cylinders, superheated steam or condensing	**MC**

Lubricant Symbol	Lubricant Description	Approx. Oil Viscosity (SUS at 100°F.) or NLGI Grease Grade
Ra	Premium grade rust and oxidation inhibited turbine and hydraulic oil.	150
Rc	"	300
Rf	"	650
M_6	Oxidation, foam and rust preventive, emulsion resistant, lead-soap extreme-pressure oil.	3300
H	Gasoline, diesel or LPG engine oil; highly detergent; highly dispersant; oxidation and foam inhibited; very high viscosity index; rust, wear and corrosion preventive; low pour; approved Supplement One oil; API Service Designation DM.	200 (SAE 10W) 550 (SAE 30)
MP	Multi-purpose grease for ball, roller, needle and plain bearings; lithium soap type containing low-pour high-viscosity (80 SUS at 210°F.) oil; wide usable temperature range; highly resistant to oxidation, high temperatures, water washing and bearing leakage; preferably supplied in grease gun cartridges.	NLGI No. 2
CC	Heavy, compounded, emulsifying steam engine cylinder lubricant for saturated or wet steam conditions.	2500
MC	Very heavy straight mineral emulsion resistant steam engine cylinder lubricant for superheated steam or condensing engines.	4800

Horizontal reciprocating air compressors[7] are extensively employed in plywood plants to produce the widely used compressed air at about 100 psi. Since it is of critical importance that these units be in operating condition at all times, plant engineers take particular care of their compressors. Properly adjusted mechanical force feed lubricators are used to provide exactly the right amount of a rust and oxidation inhibited oil having minimum deposit forming tendency and a viscosity between 300 and 650 SUS @ 100°F.

In recent years all waste wood not suitable for use in finished plywood (for example the residual central cores of peelers) has been converted into "chips," the raw material for the sulphite process manufacture of paper products[8]. The *chipper* consists of a heavy wheel driven at high speed and studded with sharp knives which almost instantaneously reduce waste wood into chips that will pass through a ¾ inch screen. Chipper bearings are both heavily and shock loaded, consequently they require the protection of a heavy-oil multi-purpose type grease in the NLGI No. 2 grade.

Short Process Manufacture

Just before this article went to press, announcement was made by a West Coast plywood manufacturer of a *short process* which combines or eliminates several of the manufacturing steps just described in the foregoing. In this short process, the green (wet) veneer is sprinkled with powdered dry adhesive, assembled into panels between face sheets covered with resin-impregnated paper, and the whole subjected to heat and pressure in a four-story high press. It is claimed that the heat and pressure of the press not only set the adhesive, but also cure (dry) the veneer and convert the resin-impregnated facing paper into a hard plastic-like coating which eliminates grain rise, cracking and sanding while providing a paint base.

SIMPLIFIED LUBRICATION PLAN

From the relatively few lubricants described in the foregoing, the reader might draw the false conclusion that industrial lubricants and lubrication methods are simple and standardized. The opposite is too often the case—a manufacturing plant usually purchases and uses far too many *specialized* lubricants than are either necessary or desirable. However, experience in many industries over many years has proven that such an unprofitable and dangerous situation can be vastly improved if, after careful study of actual *machine requirements* is made, the lubrication engineer will specify and use a minimum number of types and grades of modern high-quality, versatile, multi-purpose lubricants for the maximum number of applications. The details of such a Simplified Lubrication Plan may vary among different plants and industries,[9] but the following advantages to users are universal:

1. Fewer lubricants to order, stock and distribute; larger but simpler deliveries; possibility of automatic deliveries; less bookkeeping, less paperwork, less chance of accidentally running out of some lubricant and thereby shutting down the entire plant; simpler inventories; lower administrative costs.

2. Greatly reduced chances of misapplication, i.e. putting a specialized lubricant in the wrong place with resultant expensive machine damage, downtime and interrupted production; simpler lubrication instructions, lower service, repair and production costs.

3. Lower normal machine wear and rusting due to the superior protective abilities of high quality lubricants; lower maintenance costs.

4. Because of the foregoing, greater production at higher quality and lower cost; increased profits.

A Simplified Lubrication Plan for the Douglas Fir Plywood industry is presented on the preceding page.

SUMMARY

The Douglas Fir Plywood industry uses unique manufacturing methods in supplying huge quantities of an important engineering material to heavy construction, building and furniture industries. As in other industries, maximum advantage should be taken of the benefits of a Simplified Lubrication Plan which employs a minimum number of high quality multi-purpose lubricants for a maximum number of applications.

[7] Magazine LUBRICATION, Jan., 1954 issue, "Some Problems Associated with Compressor Lubrication."

[8] Magazine LUBRICATION, April, 1958 issue, "Paper Mill Lubrication."

[9] Simplified Lubrication Plans are available for such varied industries as Meat Packing, Passenger Cars, Bus and Truck, Industrial Trucks, Heavy Construction Machinery, Farm Equipment, Marine Pleasure Craft, Machine Tools, Printing and Associated Publishing Machinery, Dairy Industry, Grain Handling Machinery.

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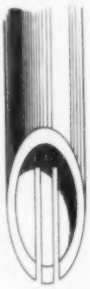
How to get more lubrication from less oil on steam engines

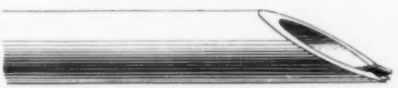
The most economical way to lubricate steam engines is to put the oil into the steam so that the heat and velocity of the steam atomizes the oil and carries it into the engine. A standard lubricator won't work as well because it simply puts drops of oil into the steam line, instead of an oil mist. (Big drops of oil generally end up on the sides of the pipe instead of going into the engine.)

To handle the oil properly you need an atomizer, or quill.

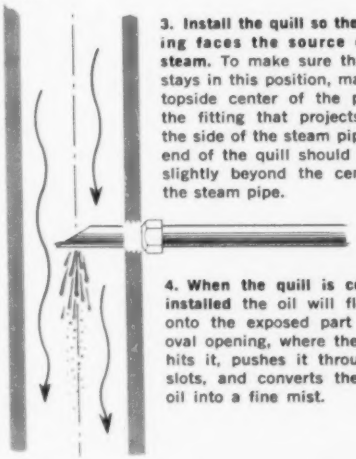
These illustrated suggestions show how to make a quill, and how to use it most effectively.



1. You can make an atomizer from a standard nipple or length of pipe of the same size as the lubricator discharge. Cut the end of the pipe at an angle, so the opening is an oval shape. Then cut two slots, each about one inch long, in the bottom, or long end, of this oval opening. Don't make the slots so long that the quill becomes weak or flexible.

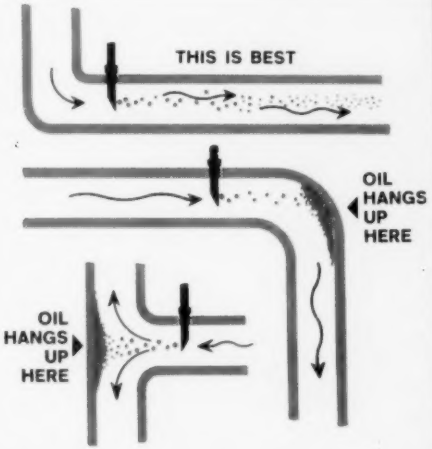


2. Bend the center section (the tongue of metal between the two slots) slightly upward, into a spoon shape.



3. Install the quill so the opening faces the source of the steam. To make sure the quill stays in this position, mark the topside center of the part of the fitting that projects from the side of the steam pipe. The end of the quill should extend slightly beyond the center of the steam pipe.

4. When the quill is correctly installed the oil will flow out onto the exposed part of the oval opening, where the steam hits it, pushes it through the slots, and converts the liquid oil into a fine mist.



5. The quill works best on a straight run, where there are no curves until the oil is fully atomized. If you install the quill near a bend, the oil will tend to stick to the sides of the pipe. Rate-of-flow is important, too. Small drops of oil, at more frequent intervals, will atomize faster and supply more uniform lubrication than large drops fed more slowly.

If you have any problems in steam line lubrication that aren't covered in this page, contact your local Texaco representative or write to: Texaco Inc., 135 East 42nd Street, New York 17, N. Y.

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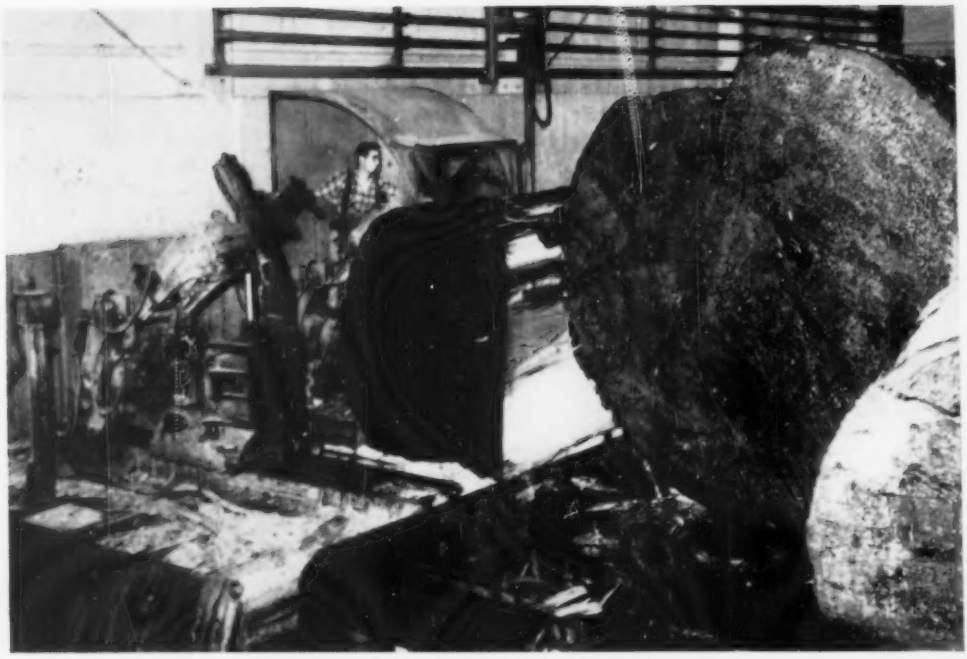

Are you using too many lubricants in your mill?

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• **Meropa Lubricant for gear drives**—stands up under severe pressure, heat and moisture. Also resists oxidation, foaming and thickening.

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